

REMARKS/ARGUMENTS

The claims are 11-18. Claim 10 has been canceled in favor of new claim 18 to better define the invention. Accordingly, claims 11-15, which previously depended on claim 10, have been amended to depend on claim 18. These claims and claims 16-17 have also been amended to improve their form or to replace the term "energy" with --current--. In addition, claim 16 has been amended to better define the invention. Also the Abstract has been replaced with an amended Abstract to improve its form. Support may be found, *inter alia*, in the disclosure at pages 4-5 and 10. Reconsideration is expressly requested.

The Abstract of the Disclosure was objected to as not being on a separate sheet in accordance with 37 C.F.R.1.52(b)(4). In response, Applicants have amended the Abstract and provided same on a separate sheet as requested by the Examiner, which it is respectfully submitted overcomes the Examiner's objection on the basis of this informality.

Claims 10 and 16 were objected to on the basis of certain informalities set forth on pages 2-3 of the Office Action. In

response, Applicants have canceled claim 10 in favor of new claim 18 and have amended claim 16, *inter alia*, to improve its form. Concerning the term "energy", this term denotes the electrical energy produced by a d.c. voltage source, for instance a solar module which produces D.C. voltage as a function of the solar radiation. Because the solar cell or photovoltaic cell converts solar energy into electricity of electrical energy by the photovoltaic effect, the term "energy" had been chosen for the language in the claims. On page 9, a current measurement unit 26 is mentioned for the determination of the produced energy. Accordingly, Applicants have replaced the term "energy" in the claims to --current-- as suggested by the Examiner.

It is respectfully submitted that the foregoing amendments overcome the Examiner's objection to the claims on the basis of the informalities set forth in the Office Action, and Applicants respectfully request that the objection on that basis be withdrawn.

The drawings were objected to under 37 C.F.R. 1.83(a) as failing to show a dead time set as a function of the detected energy as recited in claims "1" (presumably claim 10) and 16, and

a frequency set as a function of the energy detected as recited in claim 17.

This rejection is respectfully traversed.

FIG. 1 of Applicants' disclosure shows the current measurement unit 26 being connected with the control device 24. On the other side, the control device 24 is connected with the switching elements 6 to 9 of the bridge inverter 5 being able to control the switch elements 6 to 9, in dependence of the current or energy of the solar module 4 at the input of the inverter 1.

Further, FIG. 3 shows an example of the activation of the bridge inverter 5 in accordance with Applicants' invention, with the so-called dead time 42, that is the time for the shifting of one switching element 6 to 9 to a further switching element 6 to 9 arranged in series with the other switching element 6 to 9 of the bridge inverter 5. The transformer current I_{Tr} shown at the bottom of FIG. 3 has two different values representing two different energy levels delivered by the D.C. voltage source or solar module, respectively. At the point of time 56 in FIG. 3 an increase in the input energy occurs.

As a consequence of Applicants' method and device as recited in the claims, a new period duration 55 of frequency as well as a new dead time 42 is calculated or set respectively by the control device 24 and used in the next switching over period.

In view of the foregoing, it is respectfully submitted that the features of the claims are fully shown in the drawings, and Applicants respectfully request that the objection to the drawings under 37 CFR 1.83(a) be withdrawn.

Claims 10 and 12-17 were rejected under 35 U.S.C. 103(a) as being unpatentable over *Nakata et al. U.S. 5,719,758* in view of *Kuranuki et al. U.S. Patent No. 6,452,816*. The remaining claim 11 was rejected under 35 U.S.C. 103(a) as being unpatentable over *Nakata et al.* and *Kuranuki et al.* in view of *Yang U.S. Patent No. 6,597,159*.

Essentially the Examiner's position was that *Nakata et al.* discloses the method and inverter recited in the claims, except for how the dead time should be determined for the switching elements, that *Kuranuki et al.* discloses this feature, and that it would have been obvious to one of ordinary skill in the art at

the time of the invention to adjust a dead time of the bridge inverter based upon the sensed current to the bridge inverter to reduce the switching loss in the light-load period and suppress the occurrence of surge current and voltage, thereby realizing efficiency improvement and noise impression in view of *Kuranuki et al.* Yang was cited with respect to claim 11 as disclosing adjusting the switching frequency based upon the sensed primary current.

This rejection is respectfully traversed.

As set forth in amended claim 16, Applicants' invention provides a solar inverter for feeding current produced by a d.c. voltage source into an a.c. voltage grid. The inverter includes a bridge inverter, a transformer, a rectifier, a back chopper including a full bridge and an output filter. A control device is provided for controlling the parameters of the inverter, and a device for detecting the current produced by the d.c. voltage source is connected to the control device.

The bridge inverter is designed for adapting a dead time for the switching elements and/or a pulse duration, or frequency,

respectively, for the pulse width modulation as a function of the current detected. The dead time represents a time of the switching elements for switching over from one switching element to a further switching element connected in series of the bridge inverter.

As set forth in new claim 18, Applicants' invention provides a method for a solar inverter for feeding current produced by a d.c. voltage source into an a.c. voltage grid. In accordance with the method, the current produced by the d.c. voltage source is chopped in a form of a pulse width modulation by a bridge inverter by alternate switching of switching elements connected in parallel and connected in series.

The current chopped is transmitted via a transformer connected between the switching elements that are connected in series, and the transmitted current is rectified and fed into the a.c. voltage grid via a buck chopper.

For a power adaptation, the switching times of the switching elements of the bridge inverter are controlled, or regulated, respectively. The current produced by the d.c. voltage source, is detected at intervals which are cyclical, or detected

permanently, and a dead time of the switching elements of the bridge inverter is set as a function of the detected current of the d.c. voltage source. The dead time represents a time of the switching elements for switching over from one switching element to a further switching element connected in series of the bridge inverter.

In this way, Applicants' invention provides a method and a solar inverter for feeding current produced by a d.c. voltage source into an a.c. voltage grid in a simple form that substantially increases the degree of the effectiveness. By adapting the switching times of the switching elements, it is ensured that the parasitic capacities stored in the switching elements of the bridge inverter can be completely recharged and no excessively long switching pauses can occur at the same time. By changing the frequency of the switching times, the switching losses will be reduced proportionally, and thus, the degree of effectiveness of the circuit will be substantially improved.

The primary reference to *Nakata et al.* shows an inverter control method and inverter apparatus using a method with a conventional pulse width modulation (PWM) whereby a variation of the pulse width changes the operating point. In contrast,

Applicants' method and inverter makes use of the so-called "dead time", that is the time of the change over procedure of one switching element 6 to 9 to another switching element 6 to 9 arranged in series with the first switching element 6 to 9.

To clarify this situation, Applicants have amended claim 16 and have specified in new claim 18 that the dead time 42 represents the time of the switching elements for switching over from one switching element to a further switching element, connected in series, of the bridge inverter. See Applicants' disclosure at pages 4-5.

In known systems such as *Nakata et al.*, a power adaptation or power change, respectively, of an inverter is effected via pulse width modulation, wherein depending on the amount of energy delivered, the pulse width, i.e. the switched on duration of the switching elements of the bridge inverter is changed. See Applicants' disclosure at page 10.

The dead time of the switching elements for switching over from one switching element to a further switching element, connected in series, of the bridge inverter according to the so-called phase shift method is also known for a reduction of the

switching losses; however, this dead time always is a fixed value. For most applications where the D.C. voltage source always delivers a more or less constant input voltage, such a fixed dead time is acceptable for a good time is acceptable for a good level of efficiency. If the input voltage of the D.C. voltage sources, especially the solar module is not constant, a fixed dead time would result in a good level of efficiency only for certain input voltages or certain degrees of solar radiation. Variations of the energy of the D.C. voltage source or solar module, respectively, necessarily result in a reduction of the efficiency of the inverter, which can be avoided by Applicants' method and inverter as recited in the claims where the dead time of the switching elements for switching over from one switching element to a further switching element connected in series of the bridge inverter is set as a function of the detected current of the d.c. voltage source, which it is respectfully submitted is nowhere disclosed or suggested by Nakata et al.

Like Nakata et al., Kuranuki et al. fails to disclose or suggest a method or solar inverter where the dead time of the switching elements for switching over from one switching element to a further switching element connected in series, of the bridge

inverter is set as a function of the detected current of the d.c. voltage source.

Kuranuki et al. describes a switching power supply with delay circuit for light load period. Contrary to Applicants' inverter and method as recited in the claims, the dead time is set as a function of the consumed power of the power supply. It can be assumed that the input voltage of the power supply always is more or less constant, which is not the case if using solar modules.

The remaining reference to Yang has been considered but is believed to be no more relevant. Yang shows a pulse width modulation controller having frequency modulation for power converter. As explained above and in Applicants' disclosure at pages 10-11, there are essential differences between a well-known pulse width modulation and the variation of the dead time as a function of the current detected from the D.C. voltage source according to Applicants' method and inverter as recited in the claims.

Accordingly, it is respectfully submitted that claim 16 as amended, and new claim 18, together with claim 17, which depends

on claim 16, and claims 11-15, which depend on new claim 18, are patentable over the cited references. With Applicants' inverter and method, the switching losses of an inverter can be reduced and thus the degree of effectiveness of the circuit will be substantially improved.

In summary, claims 11-17 have been amended, claim 10 has been canceled, and new claim 18 has been added. The Abstract has also been amended. In view of the foregoing, it is respectfully requested that the claims be allowed and that this case be passed to issue.

Respectfully submitted,

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Enclosure: Abstract of the Disclosure

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I hereby certify that this correspondence is being sent by facsimile-transmission to the Commissioner of Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on July 24, 2008.

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